

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant(s): Marsh ) Group Art Unit: Unknown  
)  
Serial No.: Unknown )  
(Parent 09/146,408) ) Examiner: Unknown  
)  
Filed: Unknown )  
(Parent: September 3, 1998) )  
)  
For: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH  
FORMING SEMICONDUCTOR DEVICES (As Amended)

**PRELIMINARY AMENDMENT**

Assistant Commissioner for Patents  
Attn: Box Patent Application  
Washington D.C. 20231

Dear Sir:

Before taking the application filed herewith up for examination, please amend the same as follows:

**In the Title**

Please replace the title with -- METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES --

**In the Specification**

Please insert the following new paragraph at page 1, line 3 (immediately before the "Field of the Invention" heading) as instructed in the Request filed herewith:

-- This is a continuation of application Serial No. 09/146,408, filed September 3, 1998, (pending), which is incorporated herein by reference. --

Please replace the paragraph beginning at page 11, line 23 with the following rewritten paragraph. Per 37 C.F.R. §1.121, this paragraph is also shown in Appendix A with notations to show the changes made.

-- Once the adhesion layer 14 is formed, a conductive layer 18, e.g. platinum or ruthenium, is then deposited over the entire structure 10, as shown in Figure 1B. This is preferably accomplished by CVD utilizing a precursor containing a metal selected from the group consisting of platinum or ruthenium. A platinum containing precursor can be selected from  $\text{MeCpPt}(\text{Me})_3$  (where Cp = cyclopentadienyl),  $\text{Pt}(\text{PF}_3)_4$ ,  $\text{Pt}(\text{CO})_2\text{Cl}_2$ ,  $\text{Pt}(\text{CH}_3)_2[(\text{CH}_3)\text{CN}]$ ,  $(\text{COD})\text{Pt}(\text{CH}_3)_2$ ,  $(\text{COD})\text{Pt}(\text{CH}_3)\text{Cl}$ ,  $(\text{C}_5\text{H}_5)\text{Pt}(\text{CH}_3)(\text{CO})$ ,  $(\text{acac})(\text{Pt})(\text{CH}_3)_3$ , wherein COD = 1,5 cyclooctadiene and acac = acetylacetonate. A ruthenium containing precursor can be selected from the group of can have the formula  $\text{L}_y\text{RuX}_z$ , wherein L is a neutral or monoanionic ligand selected from the group consisting essentially of linear hydrocarbyls, branched hydrocarbyls, cyclic hydrocarbyls, cyclic alkenes, dienes, cyclic dienes, bicyclic dienes, trienes, cyclic trienes, bicyclic alkenes, bicyclic dienes, bicyclic trienes, tricyclic alkenes, tricyclic dienes, tricyclic trienes, fluorinated derivatives thereof, combinations thereof, and derivatives thereof additionally containing heteroatoms such as a halide, Si, S, Se, P, As, N or O; y has a value from one to three; X is a pi-bonding ligand selected from the group consisting essentially of CO, NO, CN, CS, nitriles, isonitriles, trialkylphosphine, trialkylamine, isocyanide, and combinations thereof; and z has a value from 1 to three, as described in U.S. Pat. No. 6,063,705, entitled "Precursor Chemistries for Chemical Vapor Deposition of Ruthenium and Ruthenium Oxide." Other suitable precursors can have the formula  $(\text{diene})\text{Ru}(\text{CO})_3$ , wherein "diene" refers to linear, branched, or cyclic dienes, bicyclic dienes, tricyclic dienes, fluorinated derivatives thereof, derivatives thereof additionally containing heteroatoms such as halide, Si, S, Se, P, As, N or O, or combinations thereof, as described in U.S. Pat. No. 6,074,945, entitled "Methods for Preparing Ruthenium Metal Films." These precursors can be prepared according to the methods described in the above-referenced patent applications or according to the methods described in U.S. Pat. No. 5,962,716, entitled "Methods for Preparing Ruthenium and Osmium Compounds." Other

Serial No. Unknown (Parent Serial No. 09/146,408)

Filed: Herewith (Parent: September 3, 1998)

*Title: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR DEVICES (As Amended)*

suitable precursors can have the formulae (1)  $(\text{CO})_4\text{ML}$  or (2)  $\text{M}_2[\mu-(\eta^2:\eta^4-\text{C}_4\text{R}_4)](\text{CO})_6$ , wherein M is iron, ruthenium, or osmium in formula (1) and L is a two-electron donor ligand and each R is H, halo, OH, alkyl, perfluoroalkyl, or aryl, as described in U.S. Pat. No. 5,372,849 (McCormick et al.). Preferred precursors can be selected from the group of (cyclohexadiene) $\text{Ru}(\text{CO})_3$ , (cycloheptadiene) $\text{Ru}(\text{CO})_3$ , bis(isopropylcyclopentadienyl)ruthenium, bis(isopropylcyclopentadienyl)osmium; osmium tetrachloride; tris(acetylacetonate)ruthenium; ruthenium carbonyl chloride; and penta(trifluorophosphine)ruthenium. --

Please replace the paragraph beginning at page 16, line 26 with the following rewritten paragraph. Per 37 C.F.R. §1.121, this paragraph is also shown in Appendix A with notations to show the changes made.

-- According to one embodiment of the present invention, a patterned adhesion layer 177 is formed according to the present invention by forming a metal-containing layer, e.g., titanium nitride, on the structure including surface 179 of insulative layer 183, bottom surface 185 and the one or more side walls 186 defining opening 184. The metal-containing layer is then planarized or etched back resulting in the patterned adhesion layer 177 lining the opening 184. Thereafter, a platinum layer 187' is formed over the structure 100 according to the previously described methods herein. The structure, including the platinum, is annealed (e.g., an RTO or an RTN anneal) as described herein, resulting in the platinum layer 187' adhered on the patterned adhesion layer 177 and pools of non-adhered platinum on the insulative layer 183, e.g., BPSG. The pools of non-adhered platinum are then removed, as described above. A dielectric layer 191 formed of material such as  $\text{Ta}_2\text{O}_5$ ,  $\text{Ba}_x\text{Sr}_{(1-x)}\text{TiO}_3$  [BST],  $\text{BaTiO}_3$ ,  $\text{SrTiO}_3$ ,  $\text{PbTiO}_3$ ,  $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3$  [PZT],  $(\text{Pb},\text{La})(\text{Zr},\text{Ti})\text{O}_3$  [PLZT],  $(\text{Pb},\text{La})\text{TiO}_3$  [PLT],  $\text{KNO}_3$ , and  $\text{LiNbO}_3$  can then be formed relative to the platinum layer 187'. Optionally, thereafter, a second electrode 192, including one or more conductive layers, e.g., titanium nitride, is formed relative to the dielectric material 191.

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**Preliminary Amendment**

Page 4

Serial No. Unknown (Parent Serial No. 09/146,408)

Filed: Herewith (Parent: September 3, 1998)

Title: METHODS FOR PATTERNING METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR  
DEVICES (As Amended)

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**In the Claims**

Please cancel claims 1-57. Claims 58-105 are currently pending.

**Remarks**

A sentence has been inserted at the beginning of the specification to indicate a claim of priority to a currently pending application.

Several changes have been made to identify documents by their issued patent numbers rather than by their title and docket numbers. A patent document identified as "U.S. Pat. No. 5,376,849" (page 12, line 27) has also been amended to correct a typographical error.

Amendments to the specification have also been made to include a reference numeral (187') for the platinum layer discussed at page 17.

**Summary**

It is respectfully submitted that the application is in condition for allowance and notification to that effect is respectfully requested. Claims 58-105 are currently pending. The Examiner is invited to contact Applicant's Representatives, at the below-listed telephone number, if it is believed that prosecution of this application may be assisted thereby.

**CERTIFICATE UNDER 37 CFR §1.10:**

"Express Mail" mailing label number: EL776900649US

Date of Deposit: March 19, 2001

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above and is addressed to the Assistant Commissioner for Patents, ATTN: Box PATENT APPLICATION, Washington, D.C. 20231.

By: 

Name: Louise M. Guggisberg

Date

March 19, 2001

Respectfully submitted,  
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**APPENDIX A - SPECIFICATION/CLAIM AMENDMENTS INCLUDING NOTATIONS  
TO INDICATE CHANGES MADE  
Serial No.: Unassigned (Parent: 09/146,408)  
Docket No. 150.00930102**

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**In The Title**

The title has been amended as follows:

METHODS FOR PATTERNING [PLATINUM AND STRUCTURES/METHODS  
USING SAME] METAL LAYERS FOR USE WITH FORMING SEMICONDUCTOR  
DEVICES

**In the Specification**

The paragraph beginning at page 11, line 23 has been amended as follows:

Once the adhesion layer 14 is formed, a conductive layer 18, e.g. platinum or ruthenium, is then deposited over the entire structure 10, as shown in Figure 1B. This is preferably accomplished by CVD utilizing a precursor containing a metal selected from the group consisting of platinum or ruthenium. A platinum containing precursor can be selected from  $\text{MeCpPt}(\text{Me})_3$  (where Cp = cyclopentadienyl),  $\text{Pt}(\text{PF}_3)_4$ ,  $\text{Pt}(\text{CO})_2\text{Cl}_2$ ,  $\text{Pt}(\text{CH}_3)_2[(\text{CH}_3)\text{CN}]$ ,  $(\text{COD})\text{Pt}(\text{CH}_3)_2$ ,  $(\text{COD})\text{Pt}(\text{CH}_3)\text{Cl}$ ,  $(\text{C}_5\text{H}_5)\text{Pt}(\text{CH}_3)(\text{CO})$ ,  $(\text{acac})(\text{Pt})(\text{CH}_3)_3$ , wherein COD = 1,5 cyclooctadiene and acac = acetylacetonate. A ruthenium containing precursor can be selected from the group of can have the formula  $\text{L}_y\text{RuX}_z$ , wherein L is a neutral or monoanionic ligand selected from the group consisting essentially of linear hydrocarbyls, branched hydrocarbyls, cyclic hydrocarbyls, cyclic alkenes, dienes, cyclic dienes, bicyclic dienes, trienes, cyclic trienes, bicyclic alkenes, bicyclic dienes, bicyclic trienes, tricyclic alkenes, tricyclic dienes, tricyclic trienes, fluorinated derivatives thereof, combinations thereof, and derivatives thereof additionally containing heteroatoms such as a halide, Si, S, Se, P, As, N or O; y has a value from one to three; X is a pi-bonding ligand selected from the group consisting essentially of CO, NO, CN, CS, nitriles, isonitriles, trialkylphosphine, trialkylamine, isocyanide, and combinations thereof; and z has a value from 1 to three, as described in [Applicant's Assignee's copending patent application Ser. No.

\_\_\_\_\_] U.S. Pat. No. 6,063,705, entitled "Precursor Chemistries for Chemical Vapor Deposition of Ruthenium and Ruthenium Oxide," [(Attorney Docket 97-675).] Other suitable precursors can have the formula  $(\text{diene})\text{Ru}(\text{CO})_3$ , wherein "diene" refers to linear,

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branched, or cyclic dienes, bicyclic dienes, tricyclic dienes, fluorinated derivatives thereof, derivatives thereof additionally containing heteroatoms such as halide, Si, S, Se, P, As, N or O, or combinations thereof, as described in [Applicant's Assignee's copending patent application Ser. No. \_\_\_\_\_ (Attorney Docket No. 150.00670101).] U.S. Pat. No. 6,074,945, entitled "Methods for Preparing Ruthenium Metal Films." These precursors can be prepared according to the methods described in the above-referenced patent applications or according to the methods described in [Applicant's Assignee's copending application Ser. No. \_\_\_\_\_,] U.S. Pat. No. 5,962,716, entitled "Methods for Preparing Ruthenium and Osmium Compounds," [(Attorney Docket No. 97-0861).] Other suitable precursors can have the formulae (1)  $(CO)_4ML$  or (2)  $M_2[\mu-(\eta^2:\eta^4-C_4R_4)](CO)_6$ , wherein M is iron, ruthenium, or osmium in formula (1) and L is a two-electron donor ligand and each R is H, halo, OH, alkyl, perfluoroalkyl, or aryl, as described in U.S. Pat. No. [5,376,849] 5,372,849 (McCormick et al.). Preferred precursors can be selected from the group of (cyclohexadiene)Ru(CO)<sub>3</sub>, (cycloheptadiene)Ru(CO)<sub>3</sub>, bis(isopropylcyclopentadienyl)ruthenium, bis(isopropylcyclopentadienyl)osmium; osmium tetrachloride; tris(acetylacetonate)ruthenium; ruthenium carbonyl chloride; and penta(trifluorophosphine)ruthenium.

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**Appendix A**

Page A-3

Serial No. Unknown (Parent Serial No. 09/146,408)

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adhesion layer 177 and pools of non-adhered platinum on the insulative layer 183, e.g., BPSG. The pools of non-adhered platinum are then removed, as described above. A dielectric layer 191 formed of material such as  $Ta_2O_5$ ,  $Ba_xSr_{(1-x)}TiO_3$  [BST],  $BaTiO_3$ ,  $SrTiO_3$ ,  $PbTiO_3$ ,  $Pb(Zr,Ti)O_3$  [PZT],  $(Pb,La)(Zr,Ti)O_3$  [PLZT],  $(Pb,La)TiO_3$  [PLT],  $KNO_3$ , and  $LiNbO_3$  can then be formed relative to the [adhesion] platinum layer [187] 187'. Optionally, thereafter, a second electrode 192, including one or more conductive layers, e.g., titanium nitride, is formed relative to the dielectric material 191.